



MUD CRAB FATTENING AND POST-HARVEST HANDLING

Instruction manual

Artwork by
Karl Banamu and Trevor Boslogo



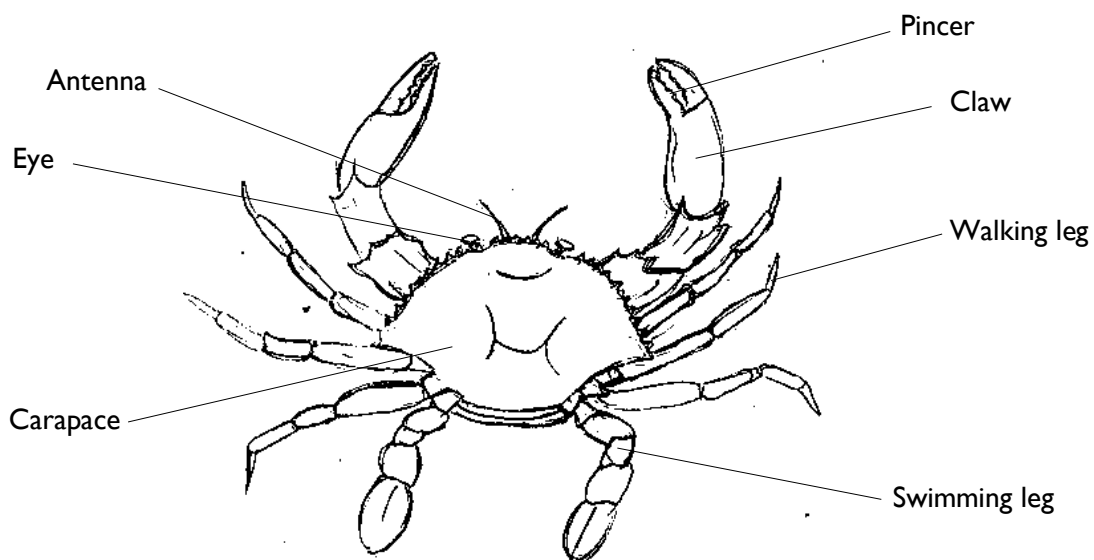
MUD CRAB FATTENING AND POST-HARVEST HANDLING METHODS

Instruction manual

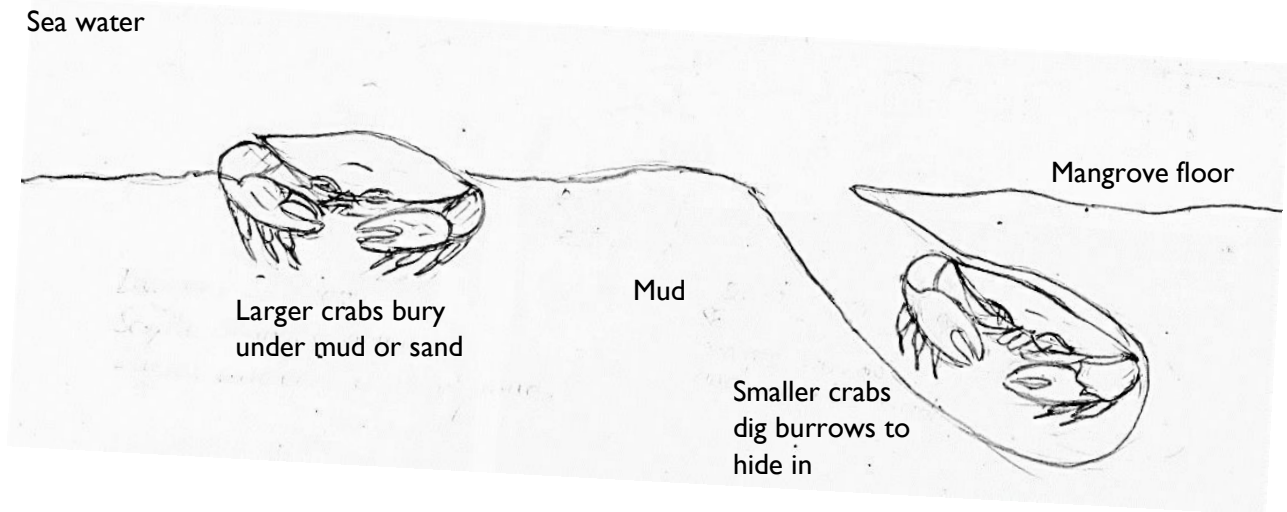
MUD CRAB BIOLOGY

Mud crabs are related to lobsters and shrimps, and live in coastal areas, including mangroves and estuaries. Like all crabs and lobsters – and insects, spiders and centipedes – mud crabs have jointed legs and a hard external skeleton that is on the outside of the animal. Mud crabs are a type of swimming crab with flattened sections on their last pair of walking legs, which allows the animals to swim. Mud crabs feed on other crabs, worms, shellfish and dead fish, as well as some plant matter.

Reproduction starts in the mangroves and estuaries with the male crab fertilising the eggs, which the female carries under her abdomen. The female then travels into the open water and releases up to 3 million eggs that remain in the open water for about 15 to 30 days, until they hatch into larvae. These larvae form part of the plankton which over a period of about 30 days' change into juvenile crabs and then into young crabs, which slowly migrate back to mangrove areas and live in burrows under the mud.



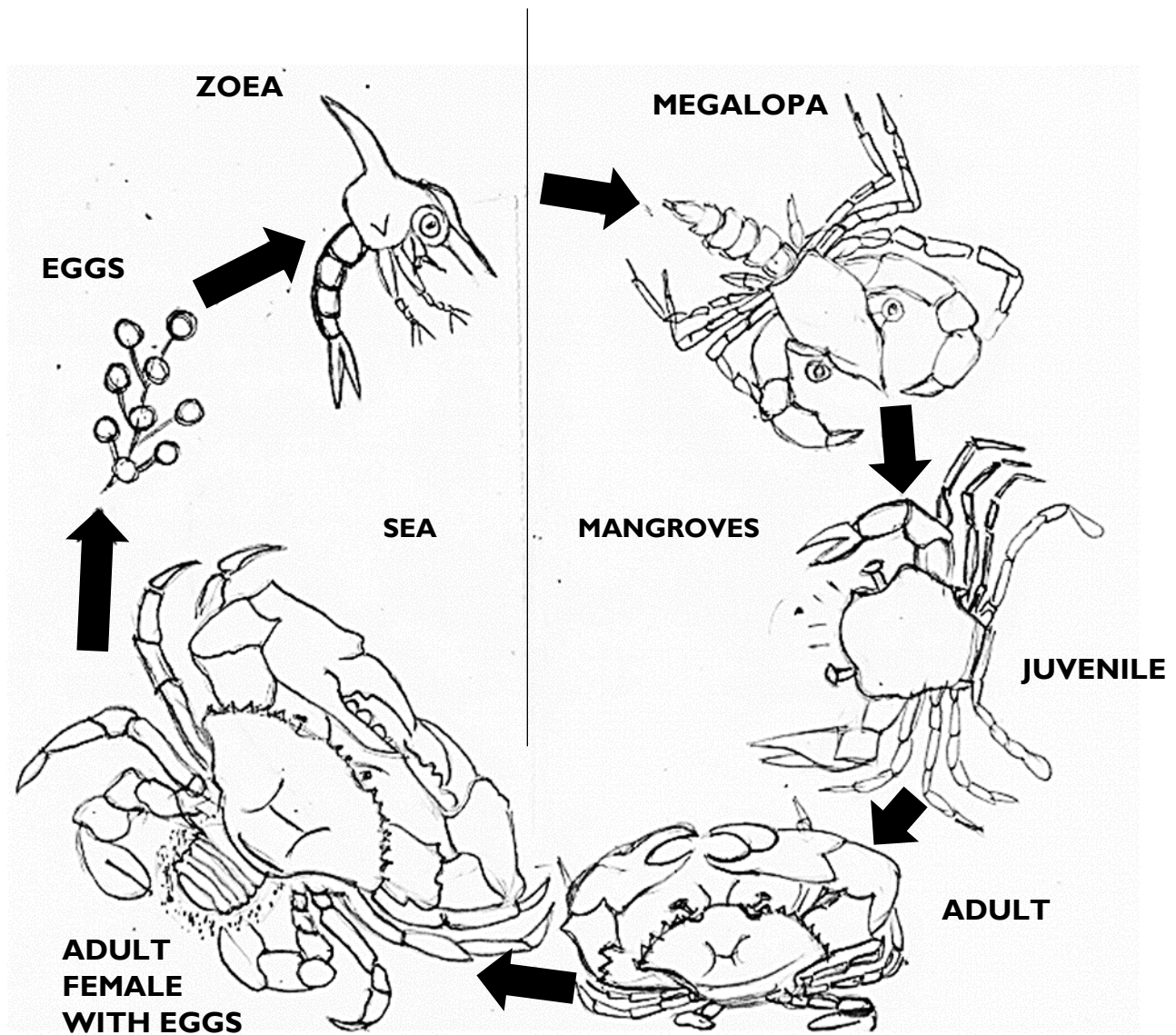
The main upper external features of a typical mud crab. Knowing the different parts of the mud crab's body will help you when learning how to fatten and look after your crabs.



Mud crabs usually live in mangrove environments or river estuaries where there are areas of mud or sand on the sea floor or river bank. Typically, larger species, such as the giant mud crab, bury themselves under the mud or sand, while smaller species, such as the green or brown mud crabs, can dig burrows into the mud and remain inside for safety. These burrows become submerged with sea water when the tide is high. At low tide, the crabs move out of their burrows in search of food, such as shellfish or dead fish, or in order to mate.

To grow and develop, young mud crabs shed – or moult – their hard outer shells. Once the old shell has been shed, the exposed skin of the crab is soft, so a new and larger shell forms around the crab and hardens, allowing growth. Usually, a mud crab goes through about 14 to 16 moults in order to develop from a larval animal into an adult. Mud crabs typically breed after moulting. In Lovongai, New Ireland Province, Papua New Guinea, adult mud crab moulting is thought to occur during new moon phases (when you are unable to view the moon because it is between the earth and the sun), with spawning usually taking place two weeks after. As such, spawning in New Ireland Province could occur throughout the year, two weeks after every new moon phase.

It can take around 1.5 to 2 years for a young mud crab to become a mature adult. Once mature, the crabs can reproduce. Adult male and female crabs can be identified by looking at the under-surface of the animal. Adult male crabs have a triangular shaped flap on their underside. In contrast, adult female crabs have a broad, semi-circular shaped flap on their undersides, which is used for holding onto the eggs. An adult female crab carrying eggs is said to be berried, and, according to the National Mud Crab Management Plan, should not be harvested. Freshly attached eggs are orange-red in colour. When the eggs are ready to hatch, they turn black.



The life-cycle of a typical mangrove mud crab. Once fertilised, the adult female crabs move from the mangrove area or estuary to the open sea and across the sea floor. When in the open sea, female mud crab released the eggs into the water. The eggs are very small (around 0.3mm in diameter) and remain in the plankton until they hatch, which can take around 15 to 30 days. When the eggs hatch, they turn into larvae, known as zoea. Zoea are very small (only 1mm long), and remain in the plankton for 12 to 15 days, where they moult – or shed their skin, allowing the larvae to grow. After five moults, the zoea transforms into a megalopa, which are small crab-like animals that have claws, and which move to mangrove areas and settles on the seafloor. The magalopa then transform into a juvenile crab. Juvenile crabs live in mangroves, and after around 18 to 24 month, transforms into an adult crab, which can then reproduce, completing the life-cycle.

1.



STAGE: Eggs

SIZE: 0.3mm

DURATION: 15 to 30 days

2.

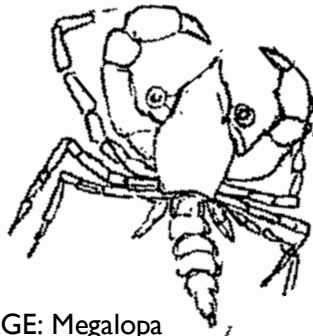


STAGE: Zoea

SIZE: 1mm

DURATION: 12 to 15 days

3.



STAGE: Megalopa

SIZE: 1cm

DURATION: 10 to 11 days

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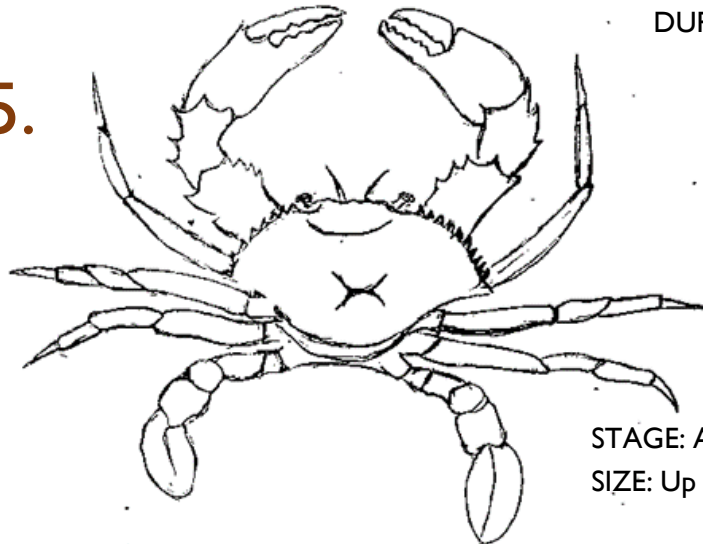


STAGE: Juvenile

SIZE: 9cm

DURATION: 18 to 24 months

5.

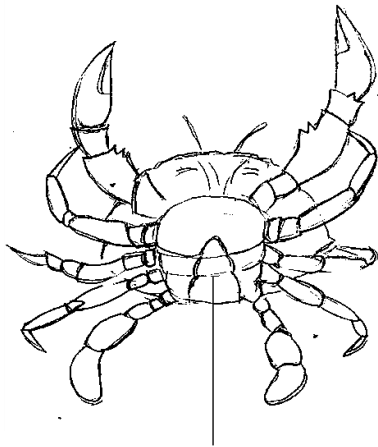


STAGE: Adult

SIZE: Up to 30cm

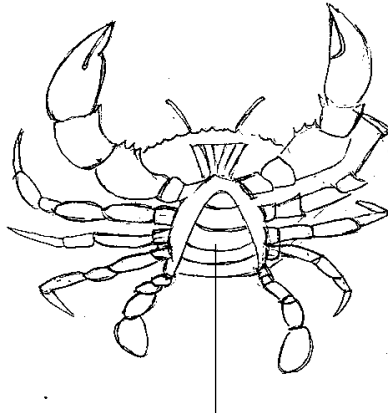
The five main stages in the life-cycle of a typical mud crab, including the average size of each life-cycle stage, and how long each of the five stages last. Once mature, adult mud crabs remain as an adult for the rest of their lives (and because they are mature they are able to release sperm or eggs into the surrounding sea water and reproduce). The drawings are not to scale.

YOUNG AND
ADULT MALE CRAB



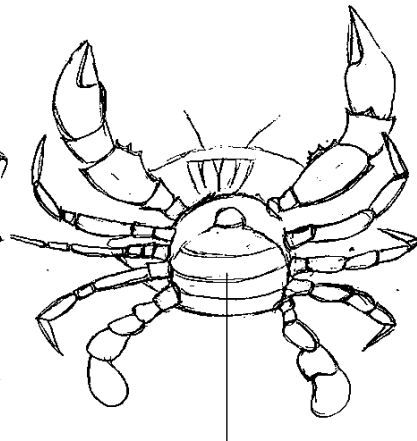
Slender, triangular-
shaped flap

YOUNG FEMALE
CRAB



Broad, triangular-
shaped flap

ADULT FEMALE
CRAB

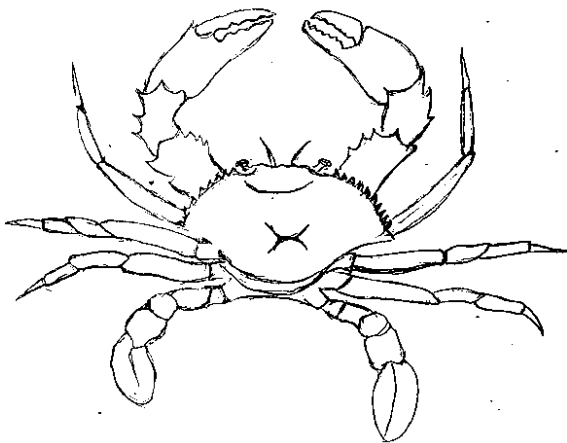


Slender, semi-circular
shaped flap

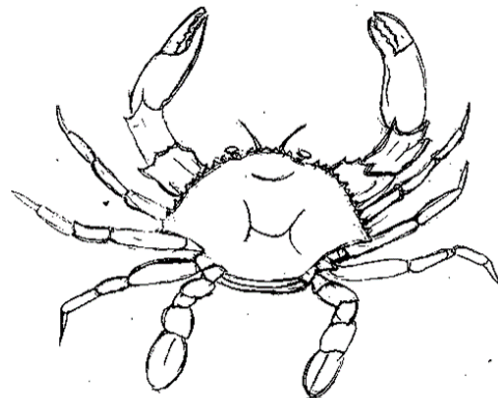
Crab genders: By looking at the underside of a mud crab, it is possible to tell the gender. Both young and adult male crabs have a slender, triangular-shaped flap on their underside. Young female crabs have a broad triangular flap on their underside. Adult female crabs have a broad flap that is semi-circular in shape – this flap is for holding onto the eggs.

MUD CRABS IN NEW IRELAND PROVINCE

In New Ireland Province, there are four species of mud crab that can be collected by local fishers. They are the purple mud crab (*Scylla tranquebarica*), the giant mud crab (*S. serrata*), the green mud crab (*S. paramamosain*) and the brown mud crab (*S. olivacea*). Mud crabs provide protein for coastal communities in the province, and are a source of income for fishers who sell crabs at local markets or to hotels in Kavieng.



Purple mud crab
(*Scylla tranquebarica*)



Giant mud crab
(*Scylla serrata*)

Mud crab sales have increased during recent years. Each year, around 28,000 crabs (20 tonnes) are sold at Kavieng Market. The average selling price of a single mud crab is 11.55 kina, and each year 323,000 kina is generated from market sales. In 2018, it was estimated that 21,000 households harvested 414 tonnes of mud crabs, which were exported to Asia, bringing 4.6 million kina to the national economy. Higher mud crab profits led to increased demands and a rise in the number of crab farms in the Asia-Pacific region.

MUD CRAB FARMING: FATTENING

In Papua New Guinea, mud crab farms usually involve fattening the crabs in crab pens that are located in mangrove areas.

Mud crab fattening

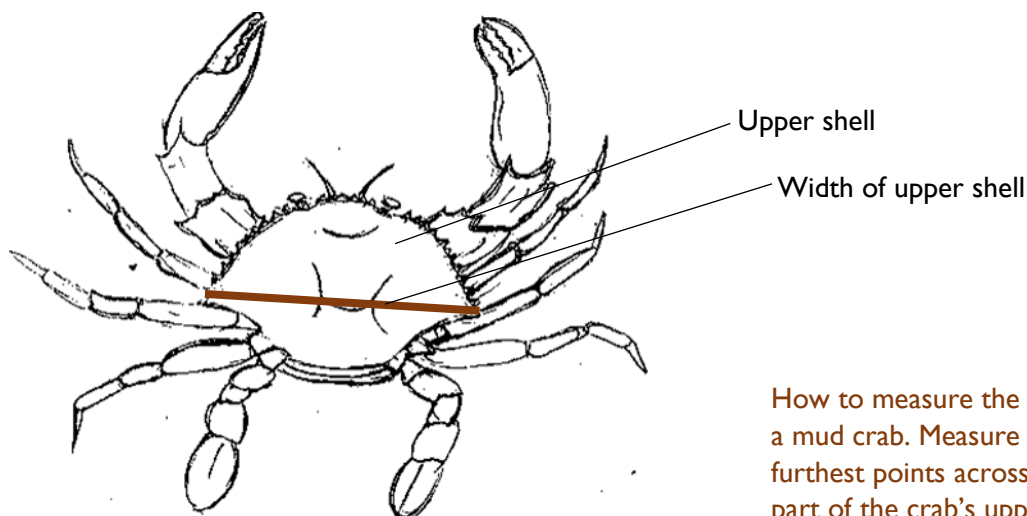
Adult crabs, with an upper shell that is around 12cm across, are collected and fed over a 15 to 30 day period. Mud crab food includes waste fish or shellfish. The crabs are fed twice a day, in the morning and in the afternoon.

The crabs need to be monitored because some grow and fatten faster than others. When the crab shells are more than 14.5cm across, they can be harvested from the mud crab farm pens and sold. The crab cages can then be restocked.

The National Mud Crab Management Plan states it is illegal to harvest female crabs carrying eggs (known as berried crabs). As such, crabs carrying eggs must not be caught and put in the crab pens.

MEASURING MUD CRABS

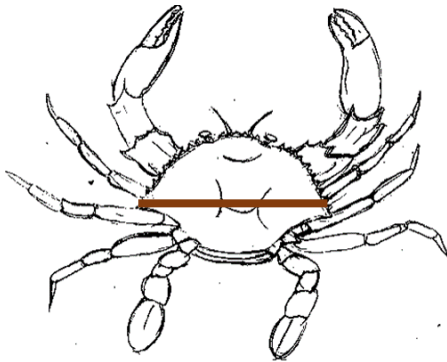
It is important to measure the mud crabs before they are collected from the wild and placed into the mud crab pens. To measure the crabs, place a ruler across the width – the widest part – of the upper shell. The upper shell is also called a carapace.



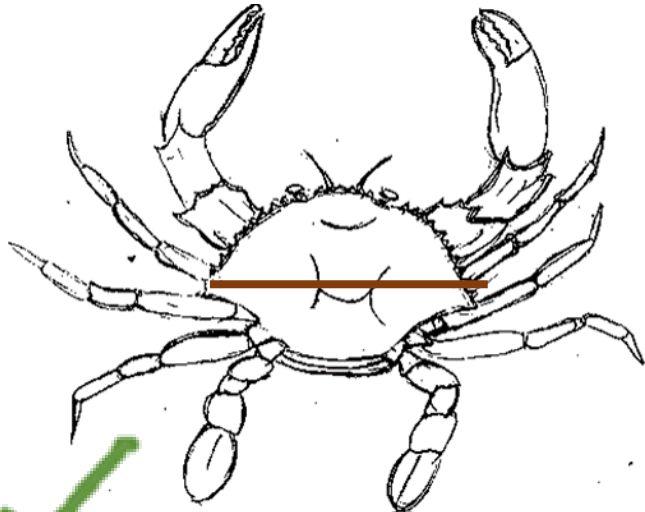
How to measure the shell width of a mud crab. Measure from the two furthest points across the broadest part of the crab's upper shell.

If the upper shell of the crab is less than 12cm, return it to the wild. This is because the crab is still young and has not had a chance to reproduce. If the upper shell of the crab is wider than 12cm, and if the crab is a male, it can be collected and placed in the mud crab pen.

IN THE MANGROVES



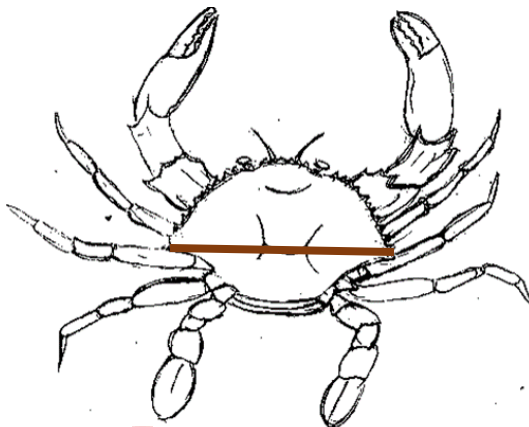
Crab with an upper shell width less than 12 cm



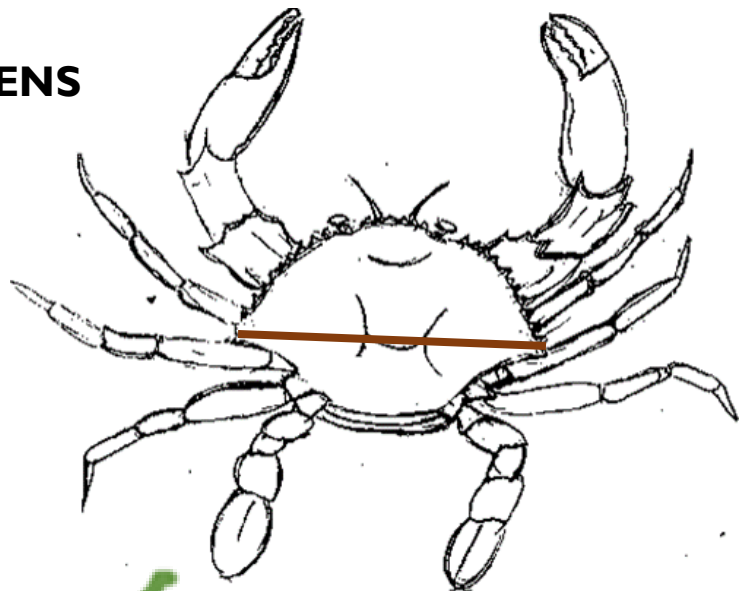
Crab with an upper shell width greater than 14.5 cm

Keep monitoring and measuring the crabs that are in the pens. Once the upper shell of the crabs are wider than 14.5cm, then they are ready to be harvested for sale. A crab that is larger than 14.5cm will make more money for you and your family.

IN THE MUD CRAB PENS



Crab with an upper shell width less than 14.5 cm



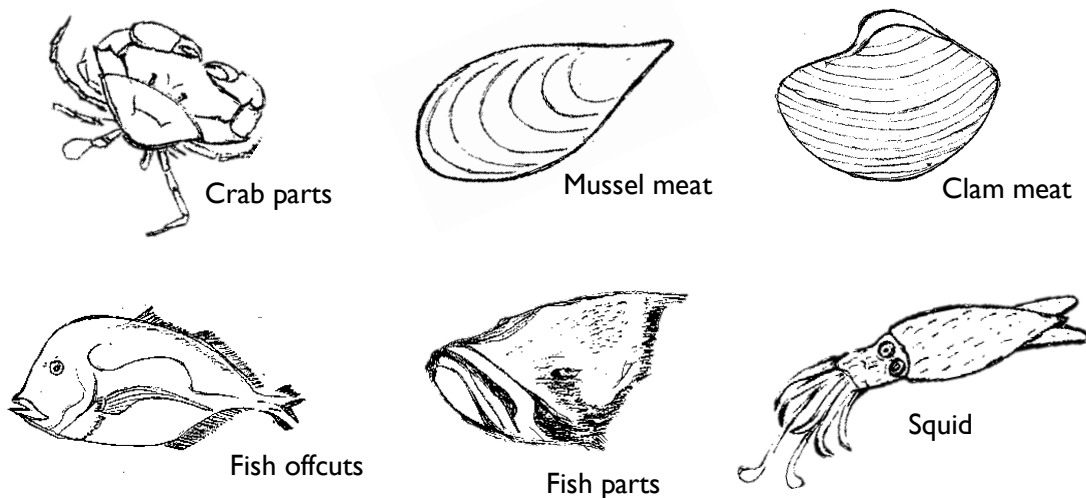
Crab with an upper shell width greater than 14.5 cm

Young mud crabs are small and have not had a chance to spawn and reproduce. When mud crabs grow in size, they become mature adults, which means they can spawn and reproduce. The PNG National Mud Crab Management Plan states that mud crabs cannot be harvested until their upper shells are over 12cm wide. Therefore, no mud crabs in your mud crab pens should be harvested from the wild unless they have upper shells that are more than 12cm wide.

The community-based Fisheries Management Plans for Salapiu, Tugalop and Kavitongong (Ungalabu Harbour Fisheries Management Plan) state that mud crabs cannot be harvested unless they have an upper shell that is more than 14.5cm across. Therefore, to follow the rules set by community residents, no mud crabs should be collected from the Salapiu, Tugalop or Kavitongong mud crab pens that have a carapace width less than 14.5cm across.

MUD CRAB FOOD

Mud crabs are scavengers in mangrove environments and estuaries and feed on a number of different food items. Crab food can include decaying fish parts, including off-cuts and scraps from the kitchen, as well as shrimps, squid, other small crabs and shellfish. Mud crabs can also compliment their diet with some plant matter, although the animals will grow quicker with animal-based food items. Use kitchen waste and scraps for feeding the crabs, rather than catching juvenile fish in the wild, which can lead to environmental problems.



The mud crabs in your pens can be fed a variety of different food items. This can include the meat from inside shellfish, including mussels and clams, as well as squid or old fish and crab offcuts and scraps from the food you eat or from kitchen waste. The mud crabs can also be fed shrimp and prawn parts, and some vegetable or plant matter can occasionally be fed to your crabs, although animal products will make them grow quicker. Do not catch young fish, young crabs or other live animals to feed the crabs in your mud crab pen, because this is harmful to the environment.

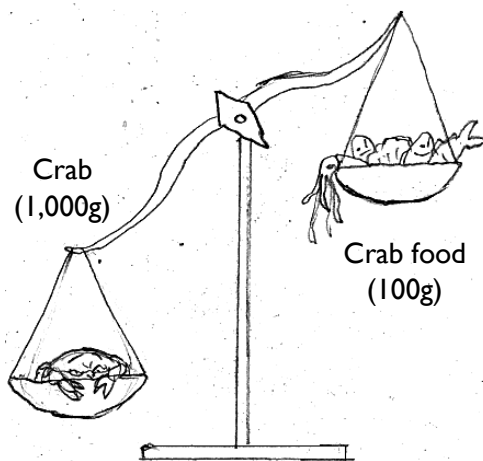
In the mud crab pens, each crab should be fed about 10% of its own body weight, and the crabs should be fed two times a day. For example, if a crab weighs 1,000g, then the crab should be fed 100g of food each day to increase growth and value.

$$\text{crab weight} \div 10 = \text{crab food}$$

So, if a crab weighed 1,000g:

$$1,000\text{g (crab weight)} \div 10 = 100\text{g}$$

$$100\text{g} \times 2 = 200\text{g (crab food: morning} = 100\text{g; afternoon} = 100\text{g)}$$



Crab food should be about 1/10 of the crab weight, which is fed to the crabs twice a day, in the morning and in the afternoon

Feed crabs 10% of their body weight, and provide this food to the crabs twice a day. So, if a crab weighs 1,000g, it should be fed 100g of food in the morning and 100g of food in the afternoon each day.

LOCATING YOUR MUD CRAB FARM

Before deciding on the location of your mud crab farm, consider the following points:

- Locate the mud crab pens close to the village so that the pens are easily accessible.
- Select an area that is sheltered from strong winds and waves.
- Make sure there is no pollution in the area, including the leaching of fertilisers and pesticides from local farming or gardening.
- Keep the pens away from sources of freshwater or major runoff areas.
- Ensure the pens will remain at least partially submerged at low tide, but in areas with good water flow.
- Situate the farm in an area with salinity levels (salt content within the water) at around 10 to 35 parts per million (ppm)
- Choose an area that is safe and secure, to reduce the risk of theft.

MAIN INSTRUCTIONS FOR CONSTRUCTING AND STOCKING THE MUD CRAB FARM PENS

Construction instructions

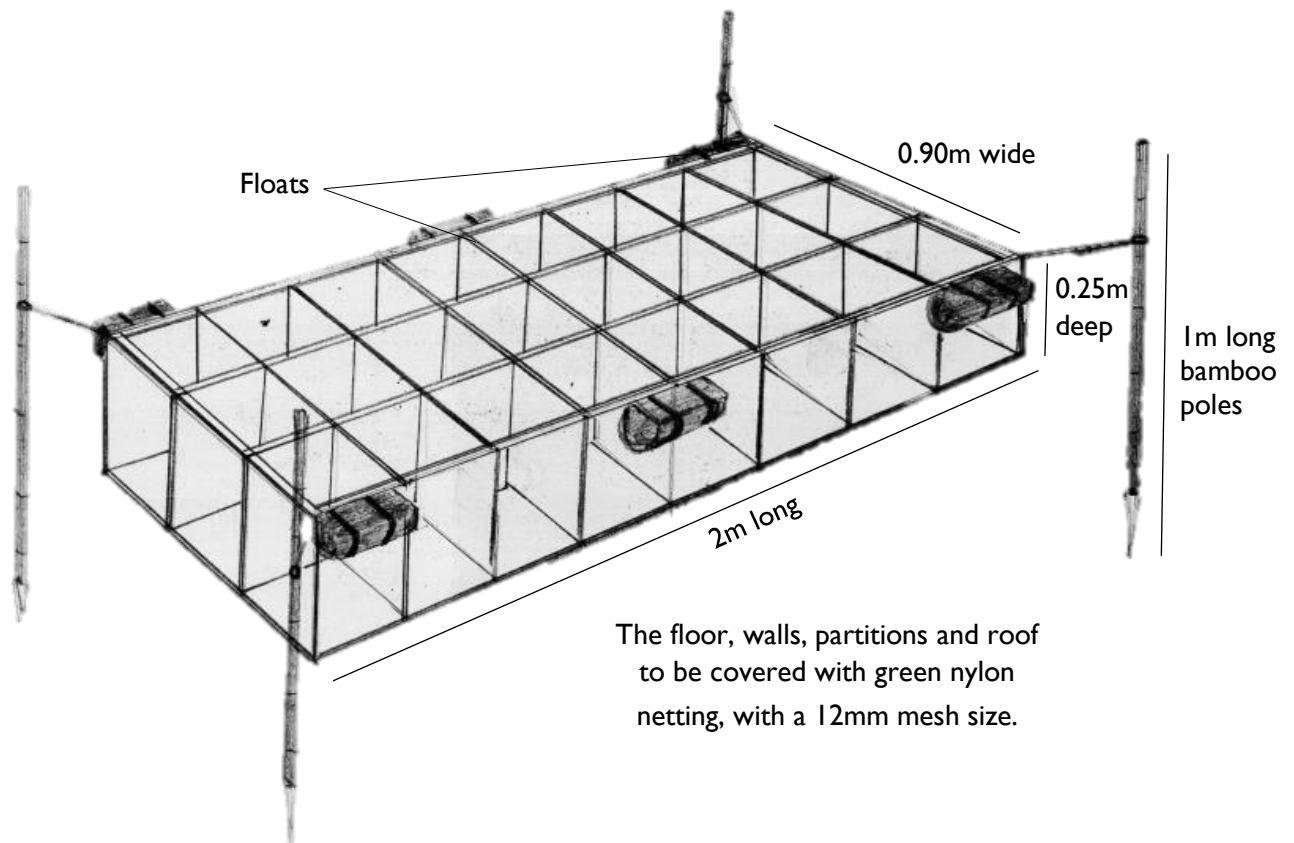
The farmed mud crabs are kept in pens that are located in mangrove areas. The pens can be constructed in the following way:

1. Construct a bamboo cage (0.25m x 0.9m x 2m), with stretched green nylon netting (12mm mesh size) providing the side walling, bottom flooring and top movable cover.
2. Within the bamboo cage, make two equal main divisions (along the length of the cage), and then seven further divisions (along the width of the bamboo cage), compartmentalising the cage into 24 individual cells (3 cells x 8 cells).
3. Make sure the upper surface of the cage is hinged, so that it can be opened and closed to prevent the crabs from escaping, and so that the crabs can be removed.
4. Attach six floats to the cages (one float in each of the four corners, and another float half way along the length of the cage)
5. Cut four 1m large, long bamboo poles to provide supports for the pen on each of the four corners.
6. The corner bamboo poles should have sharpened points at one end, so that they can be secured into the mangrove mud.
7. Add rings to the corners (which will be attached to the 1m long bamboo poles that will support the bamboo cage).
8. Position the cage along the edge of the mangrove area, making sure that around 75% of the cage remains submerged during low tide.
9. Cover the bamboo cage with coconut fronds to provide shelter for the crabs.

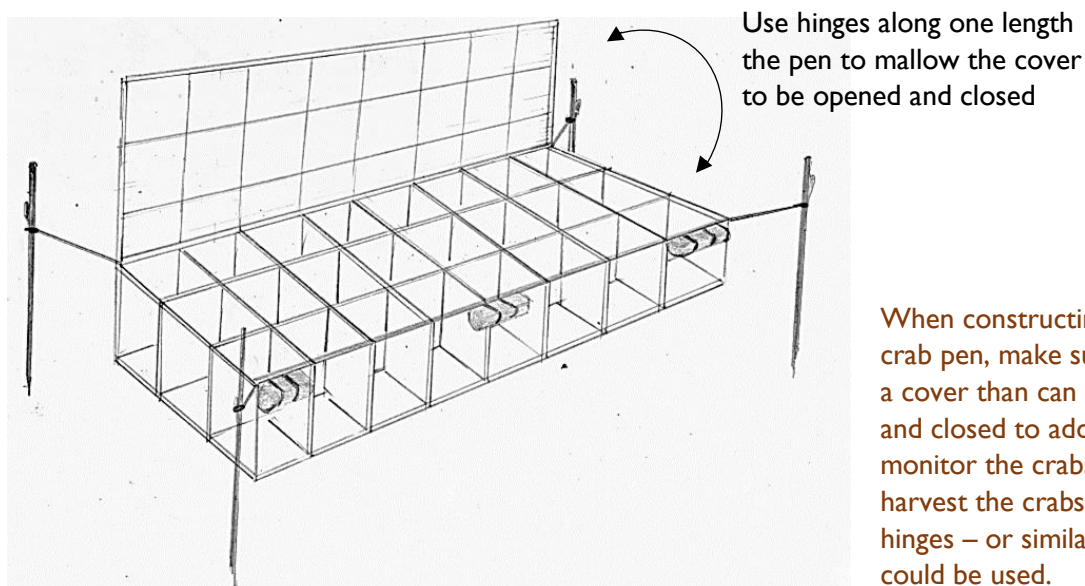
Farming instructions

Once the pens are installed in a suitable position, they can be stocked:

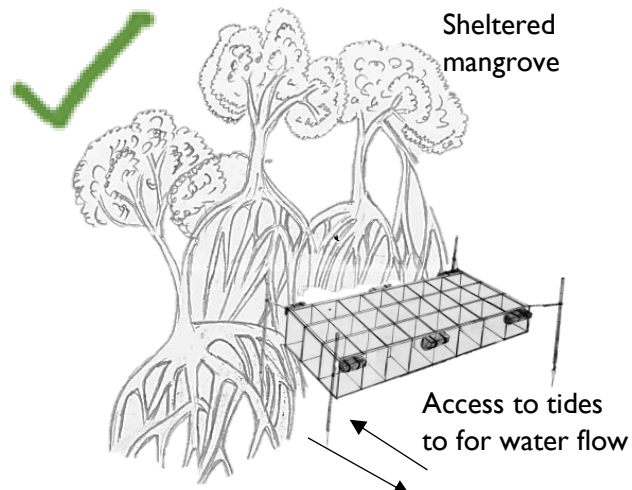
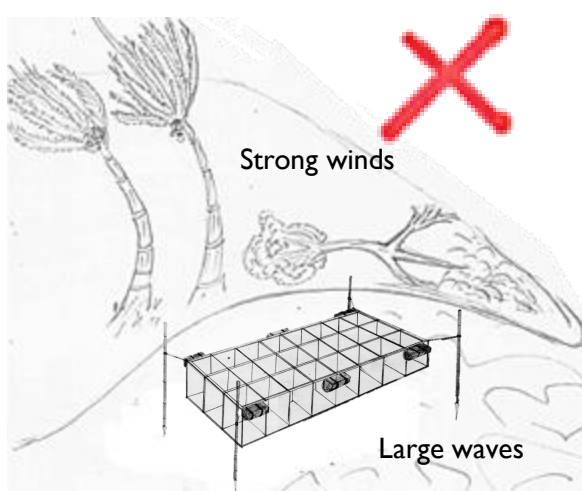
1. Place one adult male crab in each of the cells, which has an upper shell width of more than 12cm across. Crabs should not share a cell because they can fight or cannibalise one another.
2. Feed each crab with fish waste material or a mixture of 75% brown mussel and 25% fish waste each day, based on 10% of each crabs biomass.
3. Monitor the crabs each day, and selectively harvest crabs that have an upper shell width that is wider than 14.5cm.
4. Do not harvest female crabs that are carrying eggs. All female crabs that are carrying eggs should be released back into the wild.
5. If there are females in the pens that start developing eggs, they should be released back into the mangroves.
6. Crab fattening can take 15 to 30 days, depending on how large the crab is when it is placed into the pen.



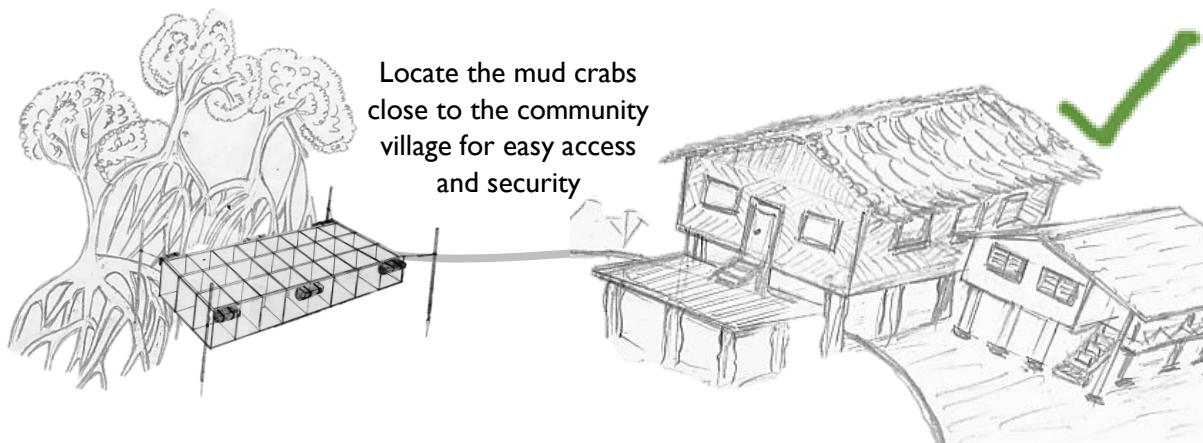
The layout of a mud crab pen, including the size dimensions. The four supporting poles are made of large bamboo canes, which are 1m long. The pen is 2m x 0.9m x 0.25m, and support 24 cages. The flooring, walls, partitions and roofing of the pen consists of green nylon netting with 12mm mesh size. The roof is hinged, forming a cover so the crabs can be placed into the pens, monitored, and removed from the pens. The cage is suspended above the mangrove mud by ropes that attach each corner of the pen to each supporting pole. Three floats are attached to each length of the pen, to ensure the pen remains accessible at high tide.



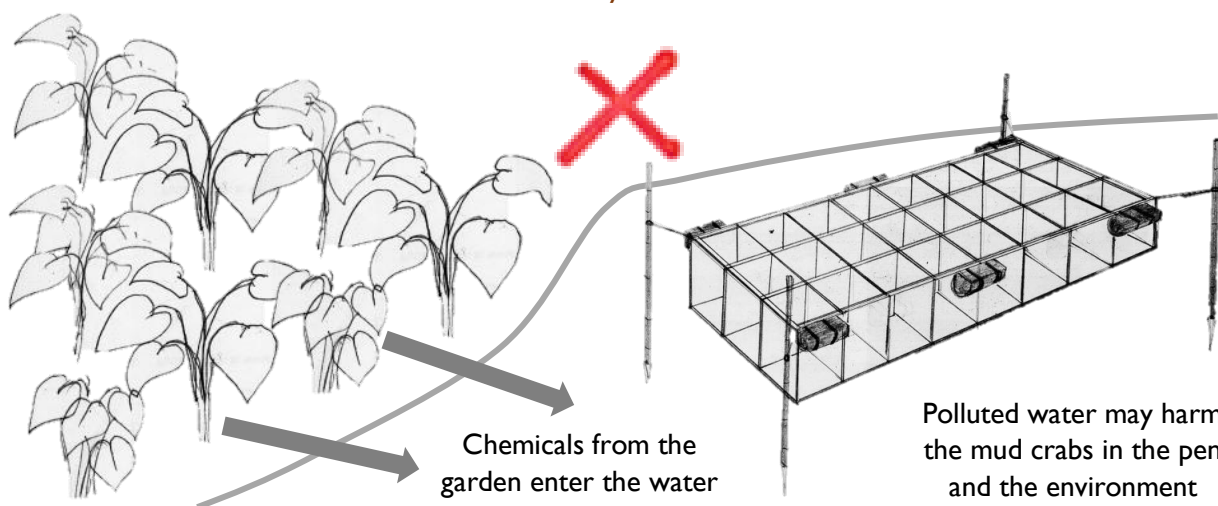
When constructing your mud crab pen, make sure there is a cover than can be opened and closed to add crabs, monitor the crabs, and harvest the crabs. Piano hinges – or similar methods could be used.



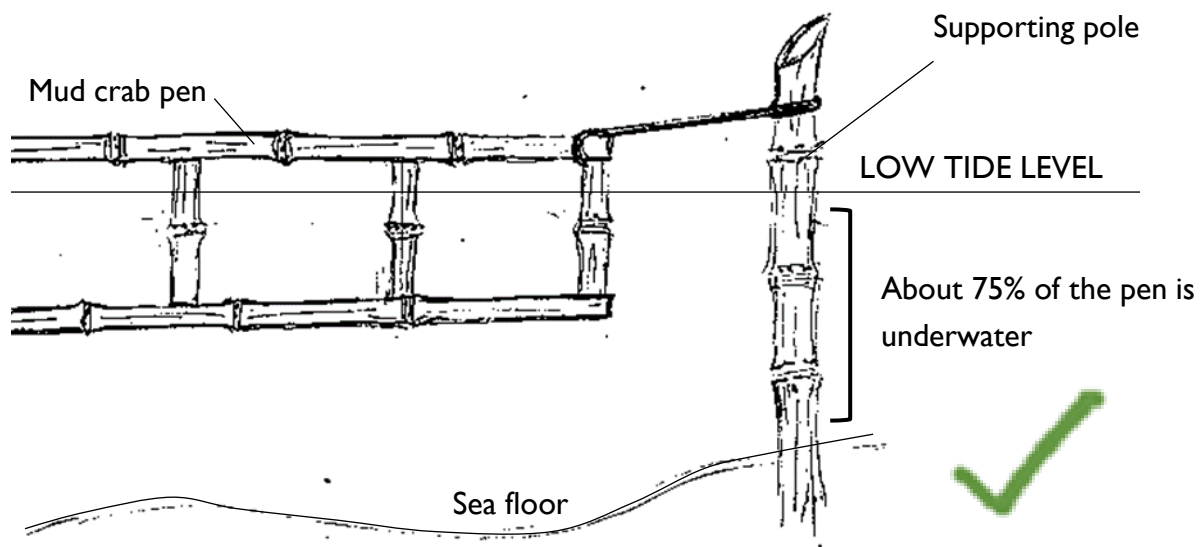
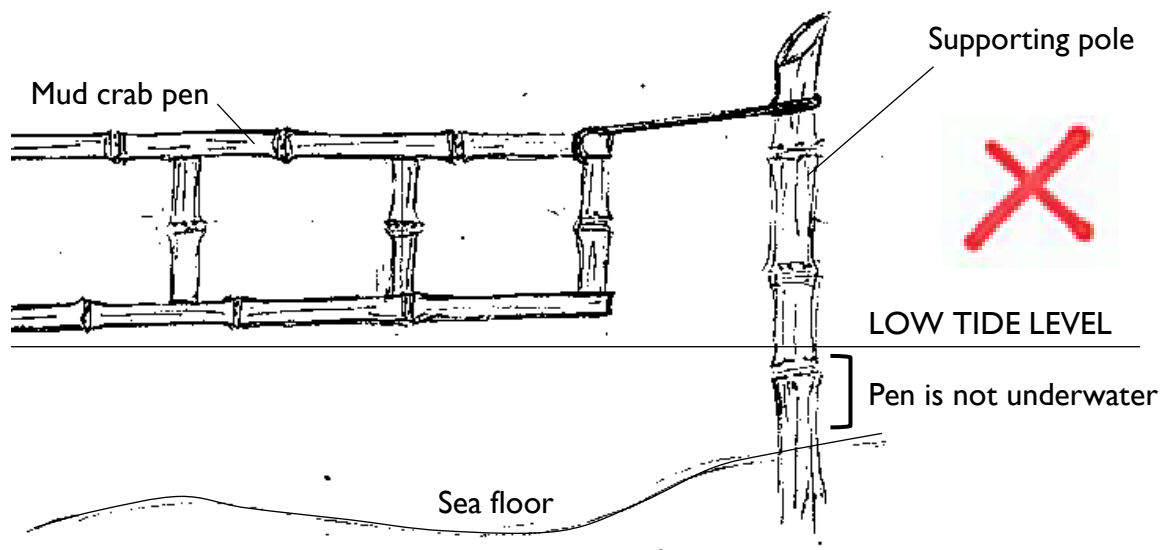
Do not locate the mud crab pens in exposed areas with strong winds and waves. Rather, locate the pens in sheltered mangroves, yet with sufficient water movement.



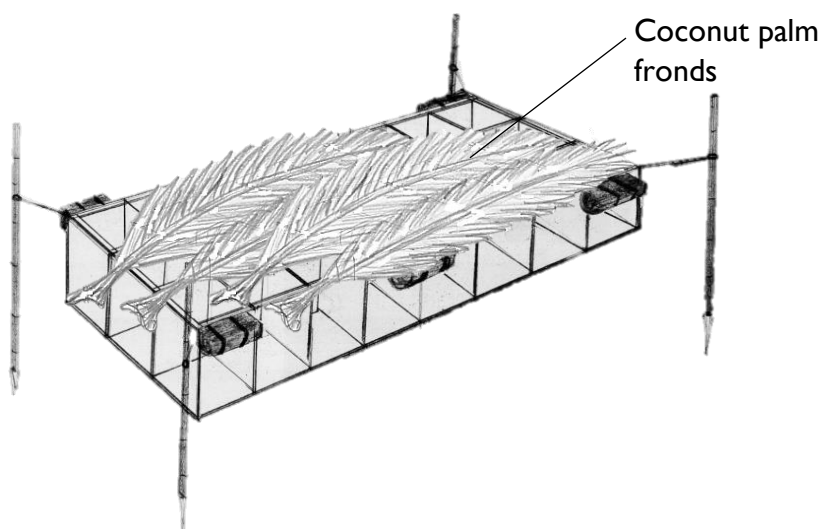
Locate the mud crab pens close to community villages so they can be easily accessed, and also to help deter residents from other communities who may wish to take some of the crabs.



Do not locate the crab pens close to areas where gardening takes place. Chemicals used on the plant crops, such as pesticides and fertilisers, may enter the water close to the crab pen and poison the crabs.



When locating your mud crab pens, make sure the pens are positioned in a location where they will be underwater during low tide. Ideally, about 75% of the height of the pen should be below the low tide water level. There should also be some form of water movement in the region. Do not position the mud crab pens in areas of stagnant water. This is important because it allows the crabs to extract oxygen from the sea water through their gills.



The hot equatorial sun can stress mud crabs during the day, and may lead to increased rates of crab mortality. Provide shade for the crabs by placing coconut palm fronds over the crab pens when they are not being stocked, monitored or harvested.

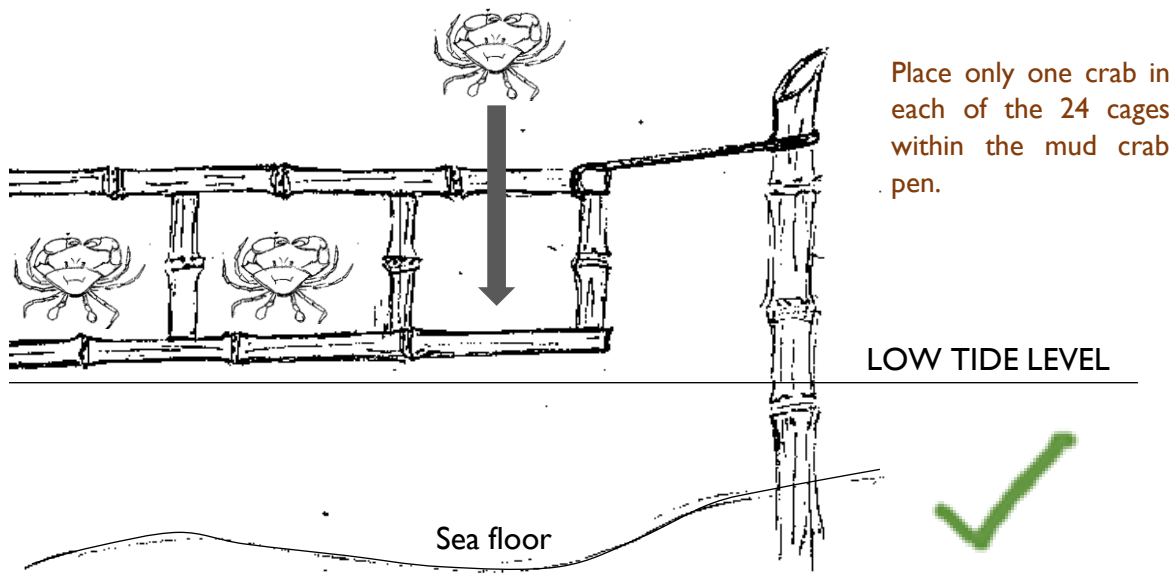
MATERIALS REQUIRED TO BUILD ONE MUD CRAB PEN

- 12 x 2m bamboo sections to provide the length struts of the pens, including the cover
- 27 x 90cm bamboo sections to provide the width struts of the pens, including the cover
- 36 x 25cm bamboo sections to provide the depth struts of the pens
- 4 x 1m long bamboo poles (4cm in diameter) for the corner posts
- 30m length of green nylon netting (25cm wide) with 12mm mesh size
- 6 x floats
- 4 x rings or attachments for the pen to be supported by the corner posts
- 6 x hinges (with appropriate screws) or ties for the pen cover to be attached to the main pen
- Catch or latch to fasten the cover
- Ball of twine
- Nails and tacks
- Cable ties

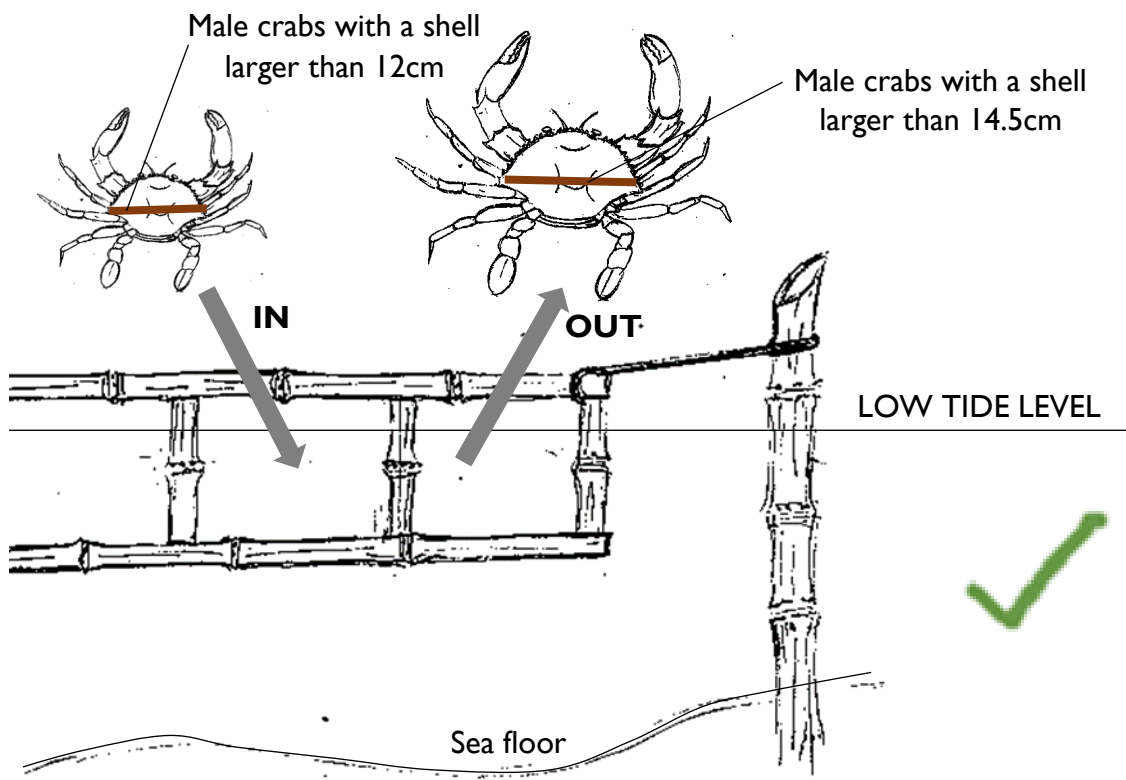
EQUIPMENT REQUIRED FOR YOUR MUD CRAB PEN

- | | |
|---------------------------|-----------------------------------|
| • Sledge hammer or mallet | • Spirit level |
| • Claw hammer | • 5m retractable tape measure |
| • Bush knife | • 30cm ruler |
| • Kitchen knife | • Top pan weighing scales |
| • Hack saw or bow saw | • Solar powered pocket calculator |
| • Scissors | • Pencils |
| • Staple gun | • Box of staples |
| • Small screwdriver | • Laminated awareness materials |
| • Stanley knife | • Log book for mud crab farmers |

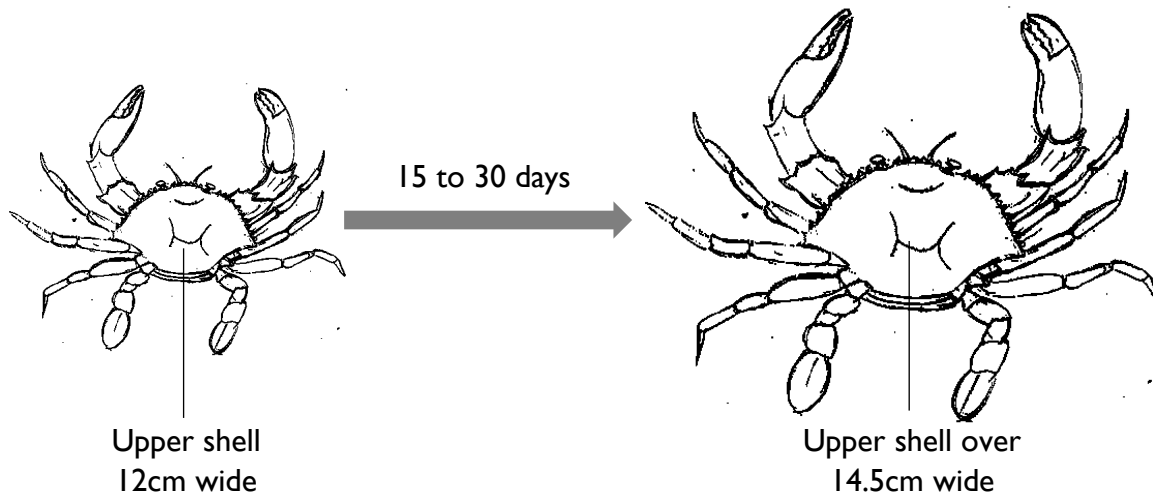
STOCKING YOUR MUD CRAB PENS



You must follow the minimum size limits when collecting wild crabs to stock your mud crab pens. When collecting wild crabs from the mangroves to put into your crab pen, make sure they are male and with an upper shell width larger than 12cm. Only harvest the crabs from the mud crab pen when they have an upper shell width wider than 14.5cm. Larger crabs will be more valuable to buyers.



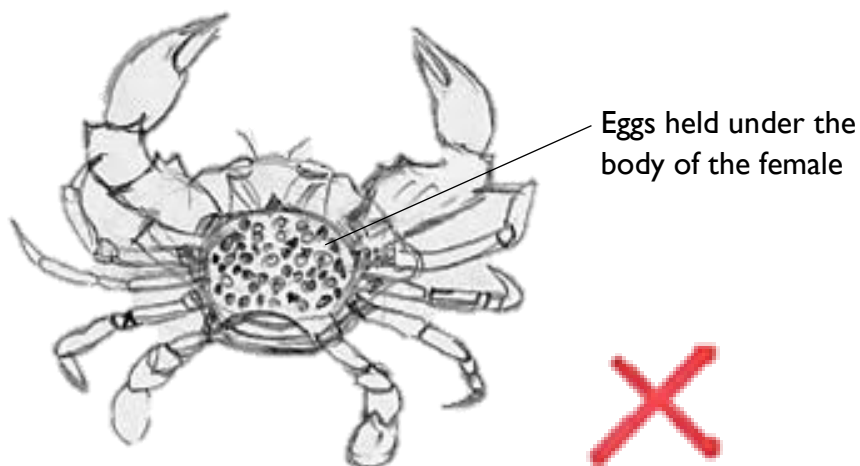
Depending on the size and species of the mud crab, it can take around 15 to 30 days for the crab to fatten so that the upper shell is over 14.5cm across.



If you feed the crabs 10% of their body weight twice a day, they should grow so that their upper shell is wider than 14.5cm. When they reach this size, they are ready to be harvested. It can take 15 to 30 days for the crabs to fatten to the required size.

When you harvest a larger crab, you can add another male crab that has a shell width wider than 12cm into the empty cage, so you can have a new supply of mud crabs for sale.

Never take female crabs from the wild that are carrying eggs. You must leave the female crabs carrying eggs so that the eggs are released, which will mean more crabs in the future. To keep things simple, aim to collect only male crabs from the mangroves, which can then be used to stock the mud crab pens.

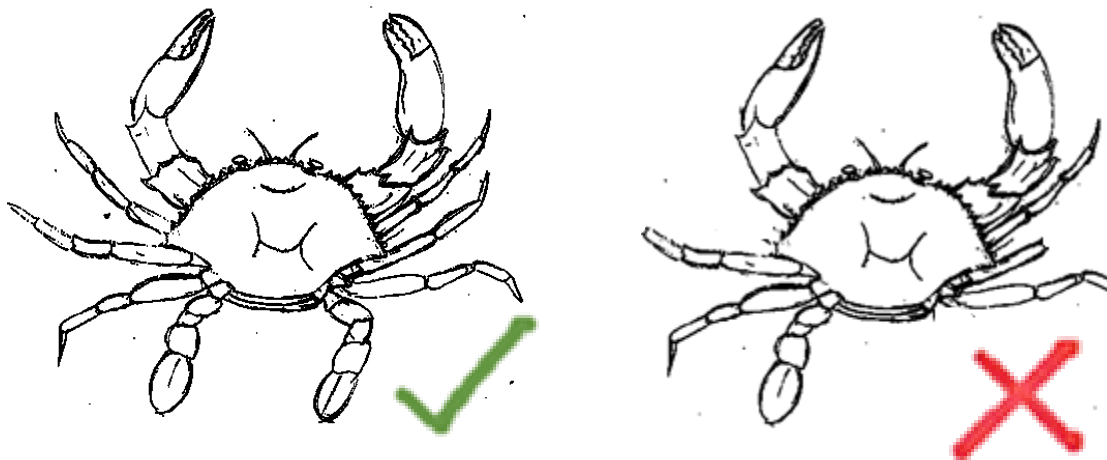


Do not take any female mud crabs that are carrying eggs from the wild. The eggs often appear as a spongy mass on the underside of the female's body. When the eggs are first laid, they are orange in colour. When they are ready to be released, the eggs turn black.

MUD CRAB HANDLING

When the farmed mud crabs have a carapace with greater than 14.5cm, and a weight that is greater than 900g, the crabs can be harvested. Do not harvest female crabs carrying eggs – they should not be in the farms and should be released.

The crabs must be alive with all their limbs and claws intact, ideally with their eyes and claws moving. To harvest the crabs from the pen cages, clutch the crab from the rear and lift from the pen with the claws facing away from your body, yet not too close to another person in case they get pinched. Small scooping baskets, constructed from chicken wire, can also be assembled to remove the crabs from the pen cages.

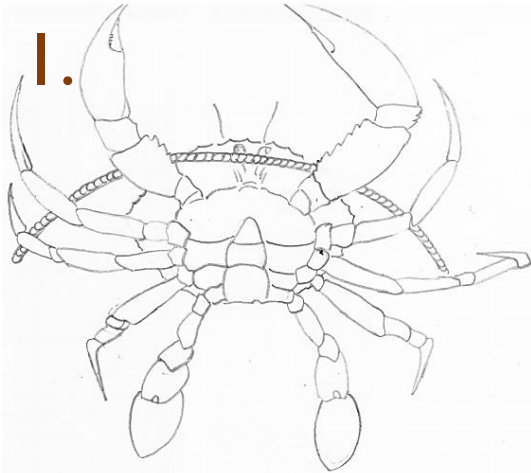


When harvesting the crabs, make sure all the limbs (legs and claws) are intact. If there are limbs missing, the crabs will be less valuable, or might not be bought.

Use twine or a strip of fibrous forest vine or dried pandanus leaf to carefully restrain the crab, with legs and claws held beside and under the body. The crabs should be washed with salt water before packing, to remove any debris or other organic matter.

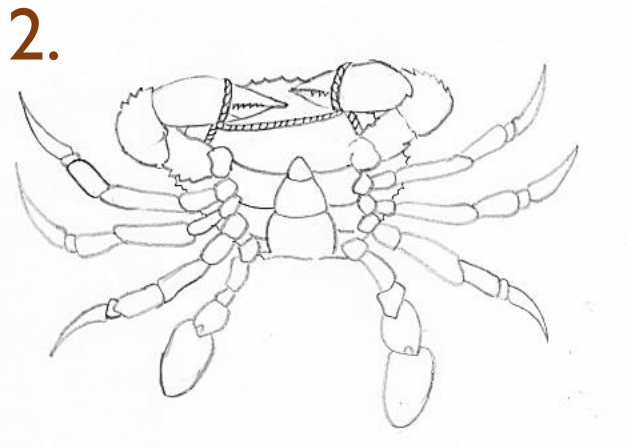
Once cleaned and tied, the crabs should be placed side by side in a polystyrene box, with further crabs carefully stacked on top. The crabs should be stacked evenly. Do not place leaves in with the crabs or the ties. The crabs should be transported to Kavieng time on the same day they are harvested. If the crabs are not delivered the same day, they will lose weight and value, and may not survive, which means the crabs will be discarded.

WARNING: Always be careful when handling mud crabs – an adult crab's claw may cut through a finger or thumb like a pencil. If a crab happens to nip you, clean the affected area with fresh water, use an antiseptic ointment to remove any bacteria, and cover the wound with an appropriate dressing. Never place a finger or thumb into the claws of an adult or a juvenile mud crab.



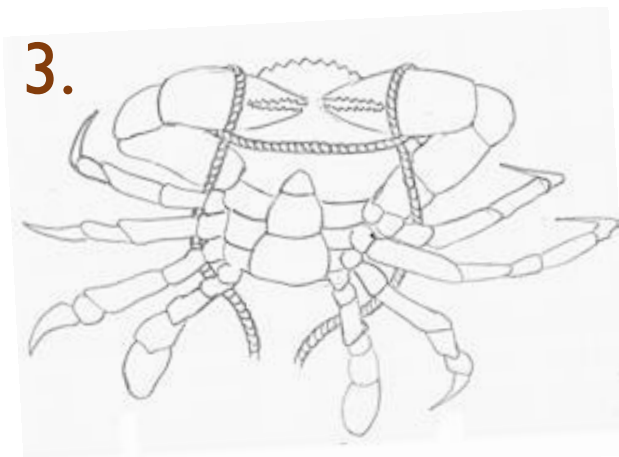
STEP ONE:

Place the rope between the mouthparts and the front part of the body



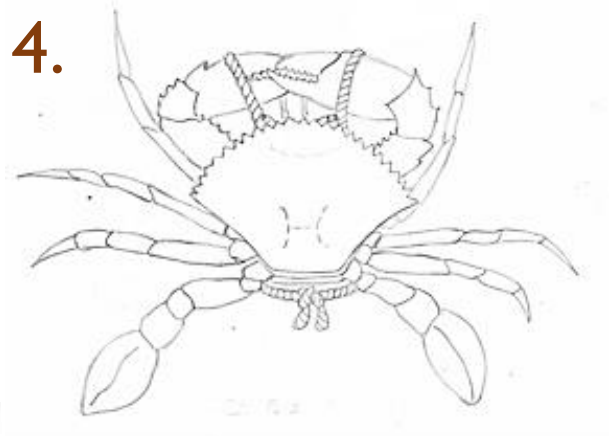
STEP TWO:

Wind each end of the rope around each claw of the crab



STEP THREE:

Position each end of the rope above the four walking legs of the crab



STEP FOUR:

Tie each end of the rope around the rear region of the crab

A suggested method for handling mud crabs when they are harvested. Twine, thin rope or forest vines can be used to handle the crabs, and secure the claws in place. Remember to make sure no legs fall off the crabs during handling, and clean the crabs with fresh seawater while removing any mud or algae from the shells. When the crabs are tied and clean, place them neatly into polystyrene storage boxes. Do not throw the crabs into the box – they are a living resource and need to be looked after. The crabs need to be taken from the pens to the buyer during the same day so that the crabs are in good quality when the buyer inspects them.



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PACIFIC COMMUNITY

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